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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/717,975	11/20/2003	James F. Cameron	51200	7999

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EXAMINER	
WALKE, AMANDA C	

ART UNIT	PAPER NUMBER
1752	

DATE MAILED: 08/12/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/717,975	Applicant(s) CAMERON ET AL.	
	Examiner Amanda C. Walke	Art Unit 1752	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *20 May 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1 and 22* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1 and 22* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

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DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Knors et al (5,800,963) in view of Brunsvold et al (5,338,818).

Knors et al disclose a composition and methods for the use and manufacture thereof are provided for a polymeric dye. The composition comprises one or more aminoaromatic chromophores in conjunction with polymers having an anhydride group or the reaction products thereof. The composition is particularly useful as an underlaying antireflective coating with microlithographic photoresists for the absorbtion of near or deep ultraviolet radiation (abstract).

The present invention provides novel compositions which comprise the reaction product of a polymer having an anhydride group and an amine dye which strongly absorbs ultraviolet light having a wavelength in the range from about 365 nm to about 436 nm, or from about 193 nm to about 300 nm. By means of the reaction, the polymers have at least one aminoaromatic chromophore chemically linked thereto. The aminoaromatic chromophore may be any aromatic compound having a primary or secondary amino moiety and having a high optical absorbance coefficient. The compositions of the present invention may be dissolved in various solvents to provide a composition which is useful for forming thin films. The present invention contemplates that the film may be formed by spin casting, extrusion coating, dipping, spraying, or other

methods commonly known in the art. If desired, a photoresist film may be applied over the antireflective film. Photolithographic processes comprising the step of applying the antireflective film prior to the patternwise or blanket exposure of the photoresist have improved linewidth control resulting from a reduction of the standing wave effect and also from a reduction of the reflective notching effect. The present invention also provides methods for the in situ preparation of the novel compositions from precursor compositions comprising maleic anhydride copolymers or glutaric anhydride copolymers or derivatives thereof in combination with aromatic amines. The antireflective film is formed by means of applying the precursor composition to a substrate and heating the substrate to cause further reaction, thus forming a one component antireflective film. The aminoaromatic chromophore may be an N-aryl amino compound, a benzyl amine, or another aminoaromatic compound wherein the amino group is linked to the aromatic compound by means of an intermediate group. Preferred aminoaromatic chromophores have a primary amino group. More preferred aminoaromatic chromophores have a primary amino group linked to the aromatic compound by means of a N-aryl bond. The most preferred aminoaromatic chromophores are selected from the group consisting of 1-aminoanthracene, 2-aminoanthracene, 1-aminonaphthalene, 2-aminonaphthalene, N-(2,4-dinitrophenyl)-1,4-benzenediamine (Disperse Yellow 9, hereafter referred to as DY-9), p-(2,4-dinitrophenylazo)aniline, p-(4-N,N-dimethylaminophenylazo)aniline, 4-amino-2-(9-(6-hydroxy-3-xanthenonyl))-benzoic acid, 2,4-dinitrophenylhydrazine, dinitroaniline, aminobenzothiazoline, and aminofluorenone. The worker skilled in the art will appreciate that many aminoaromatic compounds having high optical absorbance will be useful in the present invention. While the present invention is described in terms of the N-aryl imide chemical linkage, the skilled artisan will appreciate that many

chemical reactions including the imidization reaction rarely proceed to completion and that small quantities of acid, amide, and ester functionalities may be exist in the instant compositions. The presence of such groups in small quantities is anticipated by and is within the spirit of the present invention, provided however, that such compositions are essentially insoluble in aqueous alkaline photoresist developers. Polymers useful in the present invention comprise any polymer having an anhydride group. Particular examples include, without limitation, polydimethylglutarimide, poly(maleic anhydride-co-methylmethacrylate), poly(maleic anhydride-co-vinylmethylether), poly(styrene-co-maleic anhydride), and poly(acrylic anhydride), and derivatives, copolymers, and combinations thereof. Preferred polymers include polymers having a 5 membered or 6 membered cyclic anhydride group. In the disclosed compositions, the aminoaromatic chromophore is chemically linked to the polymer. The linkage results from any set of conditions giving rise to a reaction between the amine group of the chromophore and the carbonyl functionality of the anhydride group. Typically the chemical linkage involves the formation of an imide or amide, however, the skilled artisan will appreciate that such linkage may also involve the formation of other related chemical groups. It is expressly noted that the linkages of the present compositions are covalent bonds, and not ionic bonds, charge transfer complexes, nor other bond types related to association compounds. In the present invention, such covalent chemical bonds are formed by a thermal reaction, however, the skilled artisan will appreciate that other methods of inducing such reactions exist. The artisan will appreciate that said typical casting solvents used in diazoquinone novolak photoresist compositions include, without limitation: (a) those solvents recited above wherein the instant compositions are disclosed herein to be particularly useful in conjunction with photoresist films cast from solvents

comprising esters such as ethyl cellosolve acetate, ethyl ethoxy propionate, ethyl lactate, methyl cellosolve acetate, or propylene glycol acetate; each is also a well known diazoquinone novolak photoresist solvent. The artisan will further appreciate that said typical casting solvents used in diazoquinone novolak photoresist compositions also include, without limitation: (b) well known casting solvents for diazoquinone novolak photoresists such as the monooxymonocarboxylic acid esters and ethers thereof. Given the teachings of the reference that the polymers of the invention that are linked to the chromophores may be employed in combination, it would have been obvious to one of ordinary skill in the art to prepare the antireflective layer of Knors et al choosing to employ more than one resin linked to a chromophore (thus two components that carry chromophores), with reasonable expectation of achieving a material having a high optical absorbance.

The Knors et al reference fails to teach or suggest the presence of a silicon-containing component.

Brunsvold et al teach a method of synthesizing a silicon-containing positive resist for use as a imaging layer in DUV, x-ray, or e-beam lithography is disclosed. The resist contains arylsilsesquioxane polymers with acid sensitive pendant groups as dissolution inhibitors and a photoacid generator (abstract).

Positive resists are commonly used in bilayer or multilayer applications and are usually based on novolac resins, which are the condensation polymers of substituted phenols and formaldehyde. Positive resists containing a photosensitive material become soluble in the areas which are exposed to radiation. The developers for positive resists either contain metallic ions, typically sodium or potassium, or are classified as metal-ion-free developers, which primarily

contain tetramethyl ammonium hydroxide (TMAH). The metal-ion-free developers are becoming more widely used due to the cleaner processing environment. More specifically, the silicate or borate salts of metal-ion developers can cause particulate contamination around the processing equipment when residue dries. Further, the sodium or potassium can contaminate oxide films with mobile ions (column 1, line 62 to column 2, line 10). According to the invention, a positive silicon-containing photoresist is formulated by adding a photoacid generator to arylsilsesquioxane polymers having acid sensitive pendant groups. The polymers utilized in the present invention are synthesized by protecting the phenolic sites on the sidechains of a polyhydroxybenzylsilsesquioxane (PHBS) molecule with acid labile groups, which act as dissolution inhibitors. The acid labile groups include t-butyloxycarbonyl (BOC), secondary alkyl, substituted deactivated secondary benzyl and 1-(deactivated heterocyclic)secondary alkyl pendant groups. The PHBS-BOC polymer may be combined in a solution with a photoacid generator to provide an aqueous base developable silicon-containing resist that exhibits the high sensitivity required to satisfy step and scan tool throughput requirements. The resulting resist film contains approximately 14% silicon which provides good O_2 RIE resistance. Clean images down to a 0.35 micron feature size have been resolved and transferred into a 1 micron underlayer by O_2 RIE. Yet another indication of the high resolution provided by the resist is the contrast, which is greater than 9 (column 6, line 67 to column 7, line 11).

Given the teachings of the Brunsvold et al reference, it would have been obvious to one of ordinary skill in the art to prepare the material of Knors et al choosing to replace the novolak resist of Knors with the silicon-containing resist of Brunsvold which is taught to increase the

etch resistance of the resist, with reasonable expectation of achieving a material having a high optical absorbance.

3. Claims 1 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Foster et al (6,165,682) in view of Knors et al (5,800,963).

Foster et al teach radiation sensitive copolymers for use as a top layer resist in a bilayer system for use in deep UV photolithography, particularly for 248 and 193 nm photolithography, and especially for 193 nm photolithography. The invention also relates to radiation sensitive photoresist compositions comprising the new copolymers and to a process for the lithographic imaging treatment of a substrate by means of the photoresist composition, as will a process for the production of electronic components using the new copolymers in a radiation sensitive photoresist top layer coating in a 248 or 193 nm lithographic system. The reference teaches novel copolymers and blends thereof suitable for forming top layer photoimageable coatings in a deep UV, particularly a 193 nm, bilayer resist system providing high-resolution photolithography. The present invention also provides new photoresist compositions for forming photoimageable coatings on a substrate for use in 193 nm photolithography. The invention also provides copolymers with chemically amplified (acid labile) moieties and organosilicon moieties suitable for use in the binder resin for photoimageable etching resistant photoresist compositions suitable for use in 248 and 193 nm photolithographic processes. The novel copolymers (I) of this invention are prepared by reacting maleic anhydride, an alkenetrimethylsilane or alkene(tristrimethoxysiloxy) silane, t-butyl acrylate or methacrylate and methyl acrylate or methacrylate in a free radical polymerization reaction to form the novel copolymers. A bilayer coated substrate for use in deep UV photolithography is produced by applying a suitable

undercoat or planarizing layer to the substrate and then applying onto the undercoated substrate a photoimageable top layer of the photoresist composition of the copolymer (I) described in the previous paragraph. The new copolymers (I) of this invention provide photoresist compositions suitable for use at 193 and 248 nm wavelength that produce an excellent combination of adhesion, resolution and plasma etch resistance. Any suitable photoacid generator, particularly nitrobenzyl esters and onium sulfonate salts, which generate acid under the effects of active radiation from exposure sources ranging from election beam, ArF excimer lasers and KrF excimer lasers can be used to form the radiation-sensitive compositions with the copolymers of this invention to prepare the radiation-sensitive photoresist compositions of this invention.

Another aspect of this invention is a process for the lithographic treatment of a substrate by means of a multilayer technique, in which:

the substrate is provided with a first coating of a film-forming aromatic polymer material and then suitably cured, a second coating containing copolymer (I) or a blend of copolymers (I) and (II) of the invention and a substance that forms acid under the effect of actinic radiation of a wavelength of about 193 nm, is introduced on this first coating, the thus-coated substrate is irradiated in an image-forming way with radiation of a wavelength of 248 to 254 or of 193 nm, to which the photoacid generator is sensitive, the irradiated substrate is subjected to a heat treatment, the heat treated irradiated substrate is treated with an aqueous alkaline developer solution, until the irradiated regions of the second coating are removed, and

after this, the substrate is treated with an oxygen-containing plasma until the first coating is completely removed on those places where it is not covered by the second coating.

Any suitable film-forming organic polymers can be used as the film-forming organic material for the first coating (undercoat layer) with the use of the multilayer technique, such as phenolic resins, particularly novolak resins, such as formaldehyde cresol or formaldehyde phenol novolaks, polyimide resins, poly(meth)acrylate resins, styrene-allyl alcohol copolymer resins, and preferably copolymers of isobornyl methacrylate and hydroxystyrene thermally cured or crosslined with hexamethoxy melamine. The undercoat layer is generally 0.5 to 1 micron thick. The undercoat resin is first dissolved in a suitable solvent and then introduced by the usual coating processes onto the substrate, e.g., by dipping, blade coating, painting, spraying, particularly by electrostatic spraying, and reverse-role coating, and above all by spinning, and subsequently cured by methods known in the art. After the first layer is dried and cured, the second coating, containing copolymer (I) or a blend of copolymers (1) and (II) of this invention, a substance that forms acid under the effect of actinic radiation of a wavelength below 300 nm, preferably below 260 nm, and more preferably at about 193 nm, as well as other additives, if needed, is introduced onto the first coating. The second coating may also be produced with any conventional coating process, for example, one of those named above, but here also spin coating is particularly preferred. The covering layer is appropriately approximately 0.2 to 0.5 micron thick. While the reference teaches that any suitable organic polymers may be employed for the underlayer of the bi-layer resist system, and provides examples, the reference is silent with respect to the additional components of this underlayer.

Knors et al has been discussed above. a composition and methods for the use and manufacture thereof are provided for a polymeric dye. The composition comprises one or more

aminoaromatic chromophores in conjunction with polymers having an anhydride group or the reaction products thereof. The composition is particularly useful as an underlaying antireflective coating with microlithographic photoresists for the absorbtion of near or deep ultraviolet radiation. The antireflective film of the invention has improved dry etching properties.

Given the teachings of the references, it would have been obvious to one of ordinary skill in the art to prepare the material of Foster et al choosing to employ the polymers of Knors et al to increase the dry etching properties of the layer, with expectation of achieving a material having high resolution in DUV lithography.

4. Claims 1 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Motoyama (EP 408334) in view of Knors et al (5,800,963).

Motoyama et al disclose a resist comprising of a mixture of either poly 4,4,6,6-tetramethyl-4,6-disila-heptyne or poly 4,4,7,7-tetramethyl-4,7-disila-2-octyne as a host polymer and an additional reagent having at least a radical reactive on the double bond of the host polymer, and a patterning process using this resist, particularly as a top patterning resist in a bilayer system (abstract). According to example 1, the novolac underlayer (which the reference teaches may be any known underlayer), is spin coated and baked onto the substrate then the resist layer containing the silicon-containing component is applied and patterned. While the reference teaches that any suitable polymers may be employed for the underlayer of the bi-layer resist system, and provides examples, the reference is silent with respect to the additional components of this underlayer.

Knors et al has been discussed above. a composition and methods for the use and manufacture thereof are provided for a polymeric dye. The composition comprises one or more

aminoaromatic chromophores in conjunction with polymers having an anhydride group or the reaction products thereof. The composition is particularly useful as an underlaying antireflective coating with microlithographic photoresists for the absorbtion of near or deep ultraviolet radiation. The antireflective film of the invention has improved dry etching properties.

Given the teachings of the references, it would have been obvious to one of ordinary skill in the art to prepare the material of Motoyama choosing to employ the polymers of Knors et al to increase the dry etching properties of the layer, with expectation of achieving a material having high resolution and sensitivity.

Response to Arguments

5. Applicant's arguments filed 5/20/2005 have been fully considered but they are not persuasive.

Applicant has argued that the Knorr reference fails to teach a combination of polymers. As cited by the examiner in the previous office action, the reference teaches that the components of the underlayer are a polymer comprising an aminoaromatic dye chromophore and a polymer having an anhydride group, thus two distinct polymers. Furthermore, Brunsvold teaches a silicon-containing resist for use in a bi-layer system (otherwise as the resist layer coated over an underlayer/ antireflective layer), and that resist layer may also comprise an anthracene dye. The reference is not relied upon for its teaching of a dye, solely for the teaching of the resist layer that is coated over the underlayer/ antireflective layer.

With respect to the Foster reference, the reference does teach phenolic groups in the underlayer.

With respect to the Motoyama reference, the reference does teach a phenolic resin, and the Knorr reference has been relied upon for its teachings to add a dye-containing polymer to increase the dry etching properties of the underlayer, thus the rejection is maintained.

Conclusion

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Amanda C. Walke whose telephone number is 571-272-1337. The examiner can normally be reached on M-R 5:30-4.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Cynthia Kelly can be reached on 571-272-1526. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Amanda C. Walke
Amanda C Walke
Examiner
Art Unit 1752

ACW
August 8, 2005